Good agricultural practices for seed potato multiplication in Rwanda

Published by:

International Potato Center (CIP)
Registered offices: Avenida La Molina 1895, La Molina, Apartado Postal 1558, Lima, Peru
E cip@cgiar.org
I cipotato.org

Correct citation: CIP (2021). Good agricultural practices for seed potato multiplication in Rwanda • Producer handout. International Potato Center (CIP), Lima, Peru.

Acknowledgements:

This manual was developed through a collaboration between the International Potato Center (CIP), Rwanda Agriculture and Animal Resources Development Board (RAB) and Agriterra.

The manual was developed as derivative work of the manual 'Good agricultural practices for field multiplication of seed potato in Cameroon. Producer manual' published by the German Federal Ministry for Economic Cooperation and Development (BMZ) and available at https://hdl.handle.net/10568/108906 under Creative Commons Attribution 4.0 International license (CC BY 4.0).

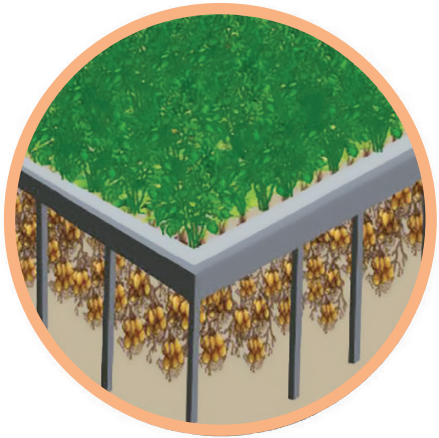
We acknowledge the contribution of representatives from Imbaraga Farmers Organisation, Delphy, SPF-Ikigega, Rwandan Potato Stakeholders Platform, INES-Ruhengeri, UR-CAVM, Horizon-Sopyrwa, Musanze District, Holland Greentech, Hollanda Fair Foods, HoReCo Rwanda, Potato Unions in Musanze, Nyabihu and Rubavu Districts and CODEPO Potato Farmers Cooperatives supported by Agriterra in Rwanda.

The development of this manual has been commissioned by Agriterra.

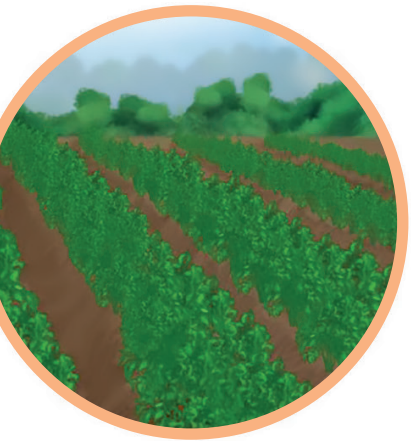
Place and date of publication:

Kigali / July 2021

Table of contents



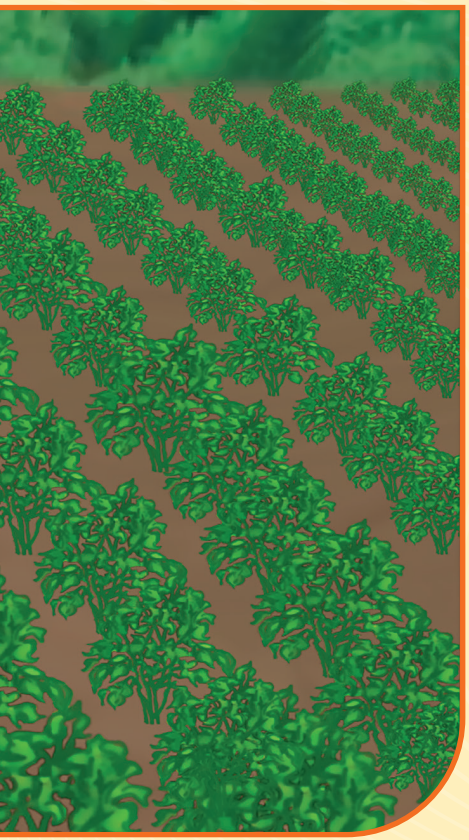
Theme 1: The seed potato value chain in Rwanda



- The use of **quality seed** potatoes is one of the most important **yield-determining factors** in potato production.
- Seed potato production in Rwanda comprises different stages:
  (1) production of in-vitro plants in a tissue culture laboratory,
  (2) production of minitubers or stem cuttings in screenhouses,
  (3) production of the third and fourth generation under field conditions (**pre-basic and basic seeds**),
  (4) further multiplication in the field to generate **certified seeds**.
- Seed production is a very technical and intensive operation. A seed potato grower in Rwanda must be officially **registered** and fulfil several criteria.
- Quality seeds need to be clearly separated from ware potatoes through branding, labelling, and creating a **separate seed value chain**.
- **Trust** between seed producers and buyers is very important for developing a local seed business enterprise.

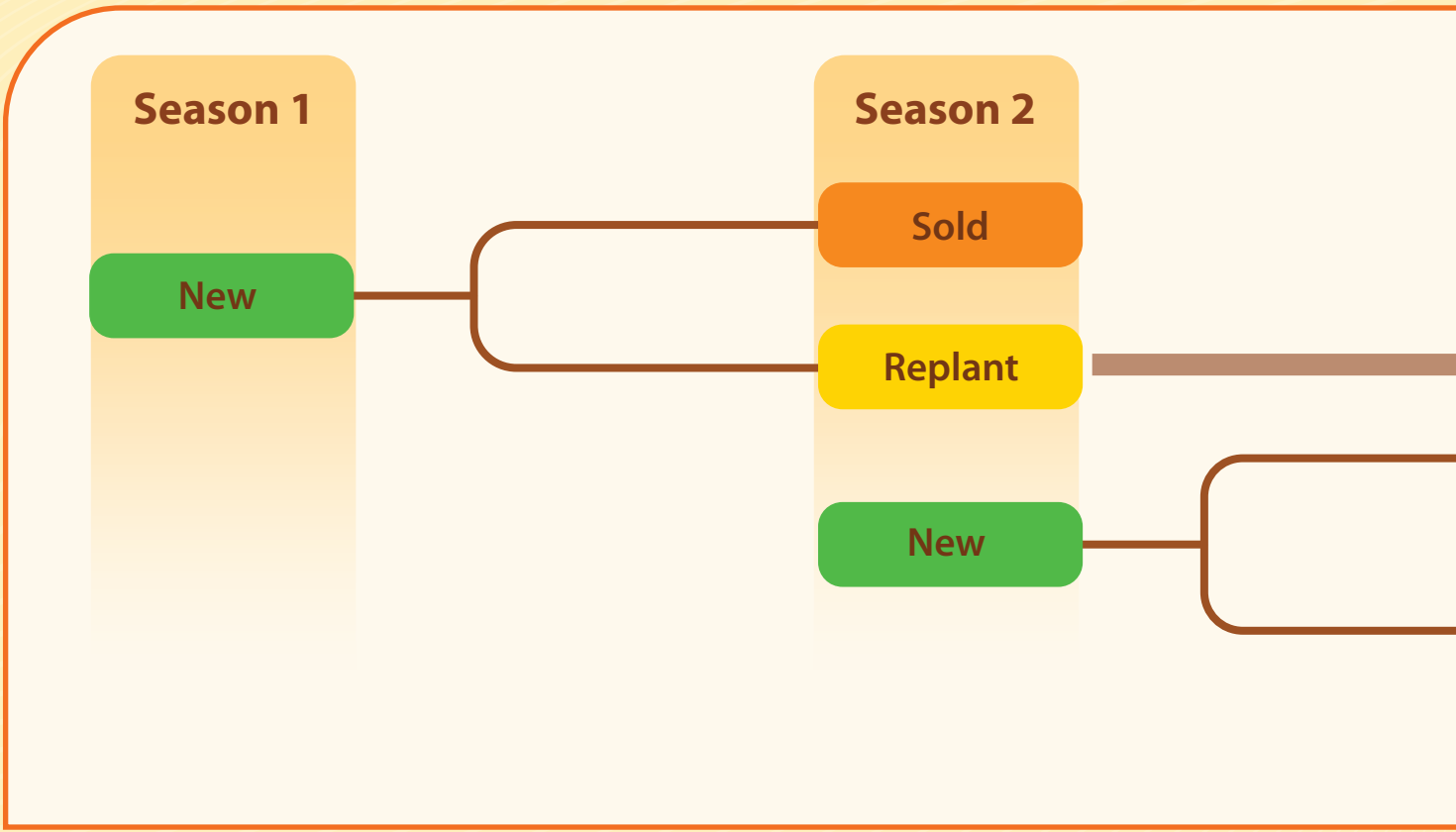
Theme 2: Seed tuber characteristics

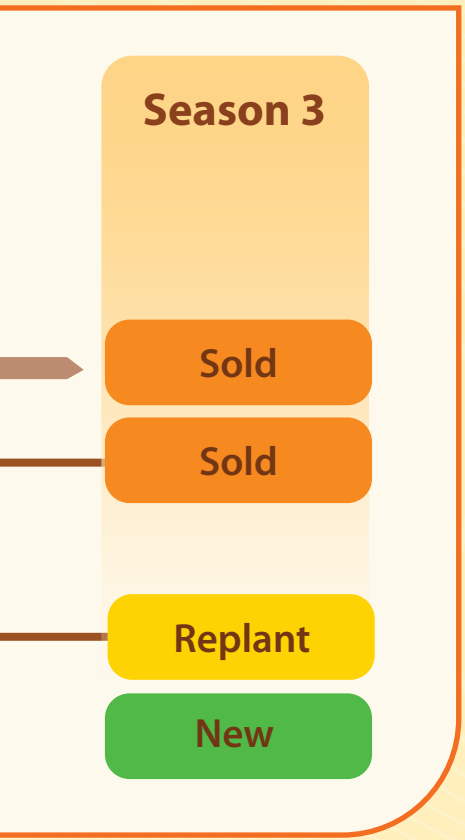
- The life cycle of seed tubers can be divided into four successive phases: dormancy, single sprout, multiple sprouts and senility.
- **Dormancy** is the stage immediately after harvest when no sprouts develop.
- After dormancy, a **single sprout with apical dominance** starts to develop from the tuber. The apical sprout can be taken off to favour the development of more lateral sprouts. This should be done not more than once.
- In the third phase, **multiple lateral sprouts** develop from the seed tuber.
- **During senility**, whitish, long and tiny sprouts are formed. These tubers are too old to be planted.
- The right time for planting is when the seed tubers have 3 to 6 **short** 1-2 cm, **strong** and **coloured sprouts**.
- It is important to understand **dormancy periods** of different varieties to plan planting and harvesting times to ensure seed is ready for timely planting.



Theme 3: Seed quality and certification

- Seed multipliers should build their **reputation** through continuously producing quality seed to gain trust with the customers.
- Seed potatoes are of **high quality** if they are free of pests and diseases, and have a uniform, small to medium size (28-55 mm).
- Seed multipliers should follow **good agricultural practices** for seed production to keep their seed potatoes free from any pest or disease.
- Potato diseases are easily transmitted by contact with infected plants, tubers, farming tools and materials, and operators crossing the field. Tools and shoes/trousers of operators should be changed or disinfected between visits to different fields.
- **Seed certification** in Rwanda is a quality assurance system whereby inspectors from RICA visit the seed producer for official control and inspection during production and post-harvest management.
- For seed certification, seed inspectors visit the multiplier **4 times** during the season, at 15 days after planting, at flowering, before harvest, and during storage.


Season 1
New
Season 2
Sold
Replant
New

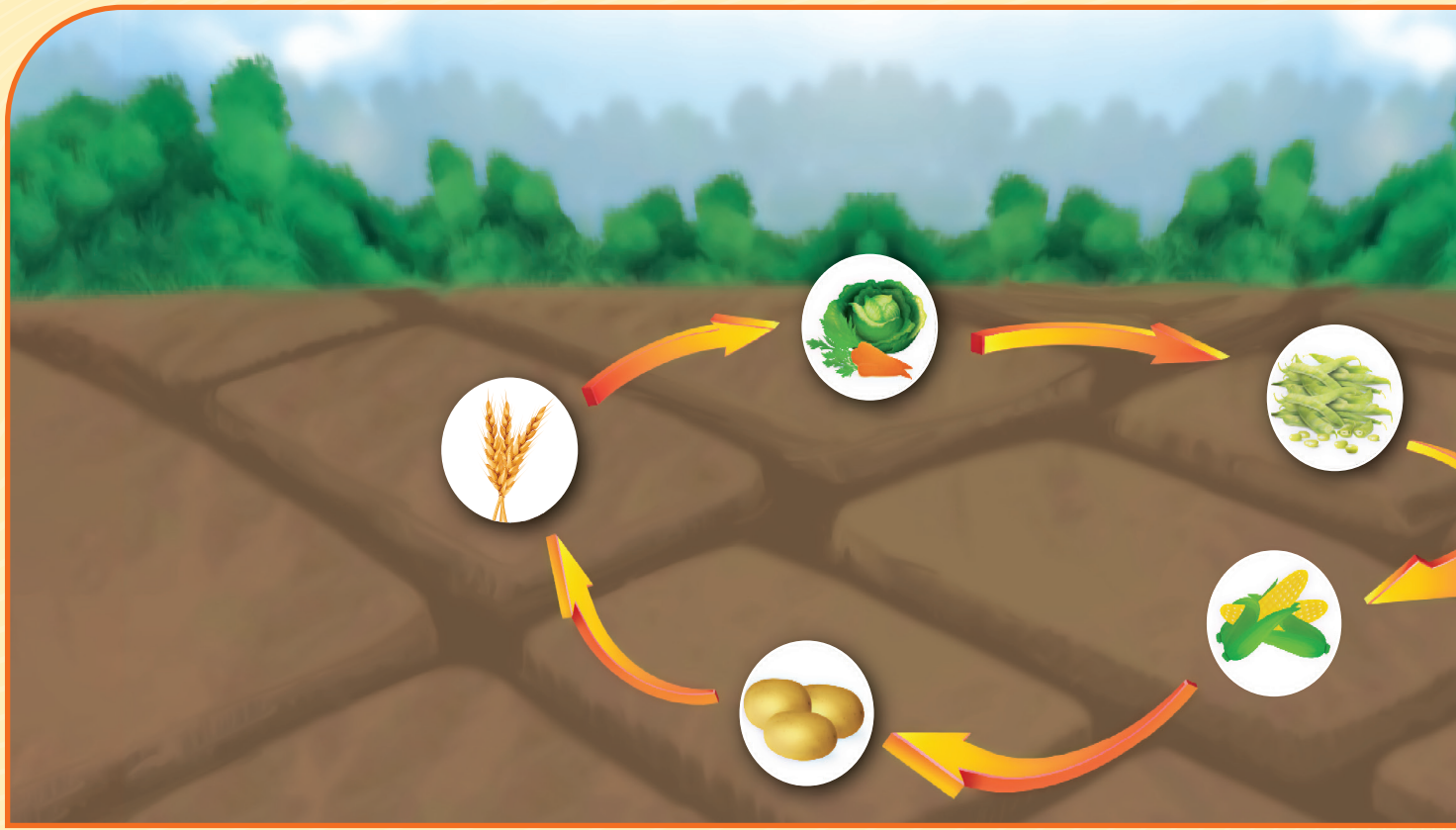


Theme 4: Seed stock replacement

- **Seed degeneration** is an accumulation of pests and/or diseases and physiological disorders in the seed tubers over successive cycles of field multiplication, causing a reduction in seed quality and yields.
- To avoid seed degeneration, seed producers must **renew** their stock of **starter (basic) seeds** regularly.
- Producers of certified seed in Rwanda should not replant seed tubers multiplied from the same stock of basic seeds more than once. Hence, producers of certified seed should **multiply a stock of basic seeds for maximally two seasons.**
- New basic seeds and seeds replanted from a past basic seed stock should be planted in **different fields.**
- Basic seeds should be obtained from **registered producers** (Rwanda Agriculture and Animal Resources Development Board (RAB), Horyzon Sopyrwa, the Institute of Applied Science (INES), or private small-scale producers of minitubers and basic seeds).

Theme 5: Record keeping

- All expenditures and income related to the seed production should be entered in **record books.**
- Record keeping is important for a seed producer to monitor expenses and **analyse the profitability** of seed production.
- Types of **expenditures** generally consist of: starter seeds, organic inputs and mineral fertilizer, sacks to package harvest produce, fungicides, insecticides, and labor.



Theme 6: Land selection and crop rotation

- The risk of pests and diseases is lower in fields at higher positions in the landscape. New stocks of starter seed should therefore be grown at the **highest position in the landscape**, while a later generation can be grown in fields at a lower position.
- **Adequate distance** (at least 20 m) between fields with seed and ware potatoes should be maintained, or barrier crops such as Napier grass, maize or other crops that are not sister crops of potato should be planted between seed and ware potato fields.
- **Soil** should be deep, well drained and loose for proper development of tubers.
- To reduce the risk of pests and diseases, select a site where potato or its sister crops (eggplant, pepper, tomato, tobacco) have not been grown for at least the last **4 seasons.**
- Plan a **5-seasons rotation** scheme, alternating potato with crops such as maize, wheat, beans, carrots, cabbage, and other legumes. Avoid planting maize before potato in fields with a history of infestation by nematodes or low soil fertility.
- Continuously remove all **volunteer plants** sprouted from left-over tubers during the rotation.


30 - 40 cm

Theme 7: Land preparation

- Ploughing can be done using a **hoe**, animal-drawn **plough, motocultivator or tractor-drawn plough.**
- Prepare land until the ground becomes soft, free from clods and dug to a depth of **at least 30 cm.**
- Proper seed bed preparation will help to improve the condition of the soil, control weeds and manage diseases.
- In case of risk of erosion or poor drainage, **ridging** should be carried out.
- Where ploughing is done mechanically, avoid the so-called "**plough-pan**" by varying year after year the ploughing depth.
- Tools used for land preparation (including tractor accessories) must be **cleaned and sanitized** before moving from one field to the other.

Theme 8: Application of manure, compost and mineral fertilisers

- Try to get a **site-specific fertilizer recommendation** based on soil characteristics of the field.
- In the absence of a site-specific fertilizer recommendation, it is recommended to apply **3 kg NPK 17-17-17 per are** (300 kg per hectare), divided in **two applications,** half at planting and half at first weeding and hilling (1.5 kg per are at planting and 1.5 kg per are at top-dressing).
- In addition to mineral fertilizer, apply up to 2 handfuls of well-decomposed manure or compost for each seed tuber at planting (200-300 kg of **manure** or **compost** per are or 20-30 tonnes per hectare).
- At planting, apply the manure or compost first, then add the fertilizers, and **cover** with 5-10 cm of soil. Then place the seed potato.
- After emergence, apply fertilizers in a hole at 10-15 cm of the plant base.
- Fertilization with high amounts of N depresses tuber growth and yield and should be avoided.

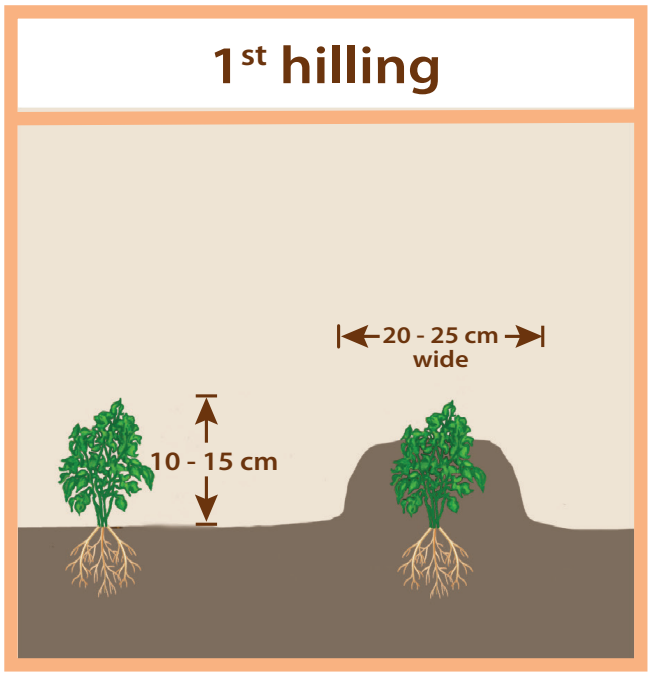
Ø: 30 mm

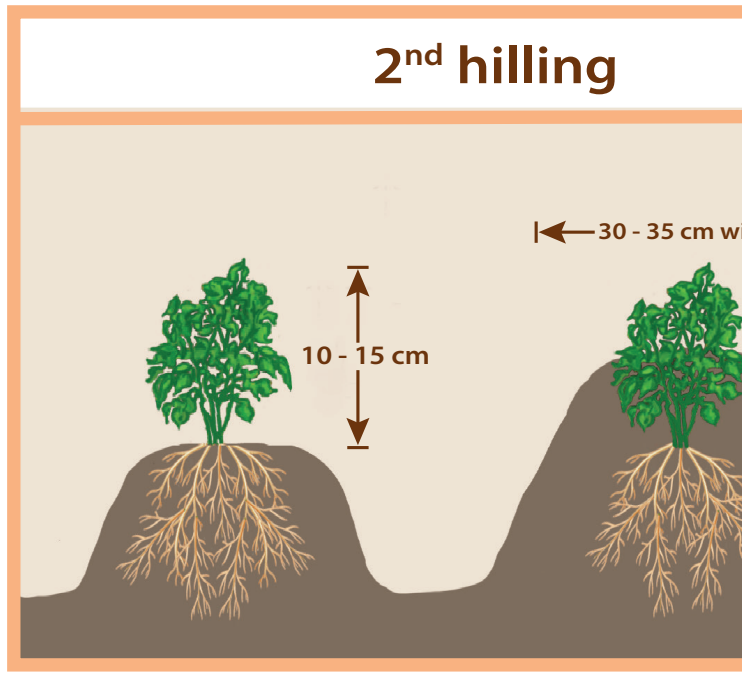
Ø: 40 mm

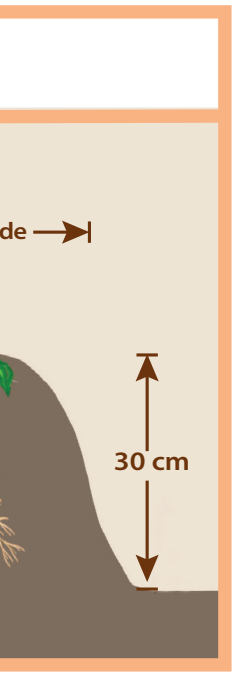
Ø: 5

Theme 9: Planting techniques

- Four to six weeks before planting, the main sprout should be taken off to promote the development of more lateral sprouts.
- Ensure the seed tubers are **well sprouted** with strong, green and short (1-2cm) sprouts and avoid old tubers with long sprouts.
- Plant seed tubers of the same size category in one area. Prepare furrows or rows of holes at a spacing of **70-75 cm.**
- Within rows, use a plant spacing of **20 cm** when seed tubers are small (around 30 mm), **25 cm** when seed tubers are medium sized (around 40 mm), and **30 cm** when they are large (around 50 m).
- Place seed tubers at a **depth of 5 to 10 cm** in holes or furrows with sprouts facing upwards before they are covered.
- On a sloping terrain, furrows or seed holes should run across the slope.


1st hilling
20 - 25 cm wide
10 - 15 cm
BEFORE
AFTER


2nd hilling
30 - 35 cm w
10 - 15 cm
BEFORE
AFTER



Theme 10: Weeding and hilling

- **Weeding** reduces competition for light, nutrients and water, and prevents weeds from harboring pests and diseases.
- First weeding should be done right after plant emergence, when the plants are about 10-15 cm tall.
- **Hilling** is mounding earth around the stems of potato plants when they are young.
- Good hilling leads to a higher number of tubers and protects the tubers from pests and diseases.
- **Two hilling** are required for potatoes planted on flat land. Do the **first hilling** at first weeding after plant emergence.
- Do the **second hilling** 2-3 weeks later. A third hilling is not recommended for seed production as it may result in tubers that are too large.
- The height of the ridge after 2 hilling should be at least **30-45 cm** with an arc of about 90 cm.


1


2


3

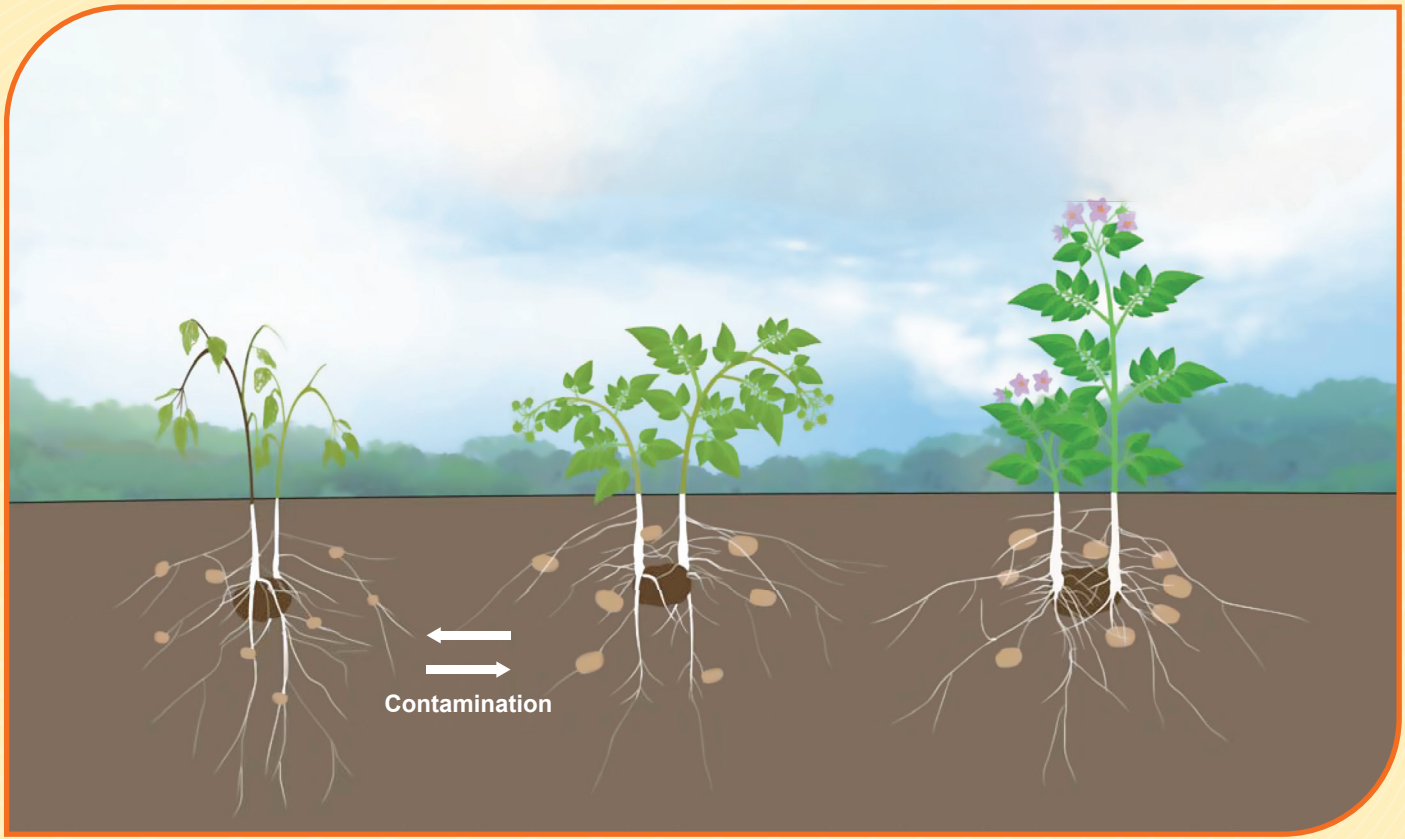

4

Theme 11: Roguing

- **Roguing** (also known as negative selection) consists of regularly inspecting the potato field and removing any abnormal plants.
- Plants to be rogued are either **diseased** (e.g., bacterial wilt), **off-type plants** (resulting from variety mix up), or volunteer plants sprouted from left-over tubers.
- A seed lot may be rejected for seed certification if roguing is not performed consistently.
- Start with roguing when plants have reached 20-25 cm of height and continue roguing **once a week** until the foliage of potato plants closes the rows.
- Field inspection works well when done early morning, while walking away from the sun for better identification of abnormal plants.
- Remove diseased plants by **uprooting the entire plant** along with the soil in which it was planted. Plants with soil should be placed in a basket or bag and taken out of the field and buried or burnt into a deep pit. Lime or kitchen ash can be applied in the hole where the plant was removed to kill the disease.

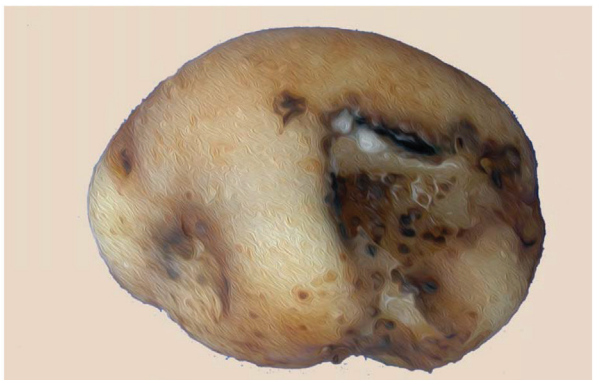
Theme 12: Control of late blight

- Late blight damages the leaves, stems and tubers. Infected leaves or stems have **grey/brown/black spots** as if they were burned. Symptoms also include white fluffy strands at the underside of the leaves.
- Late blight spreads through wind, water, soil and infected tubers and plant material. **Wet conditions** are favorable for late blight.
- Plant **clean seeds** of **less susceptible varieties** to avoid late blight in the field.
- **Collect and burn potato foliage** after harvest to sanitize the field.
- A wider plant spacing reduces humidity in the field which can help to reduce late blight.
- Use **contact fungicides** (e.g. Mancozeb) to prevent infection and **systemic fungicides** (e.g. Ridomil) to treat infection:
    - Spray a contact fungicide right after plant emergence when the plants are around 10 cm tall.
    - Spray a systemic fungicide 40-45 days after planting only if there is a lot of rain and a lot of late blight in the area.
    - For subsequent sprays, use contact fungicides at 2-weeks interval, except when disease symptoms are visible in the field. In that case, use a systemic fungicide. Once disease symptoms have disappeared, return to spraying with a contact fungicide.
- When using fungicides, always use the **dosage** that is recommended by the manufacturer.
- Contact fungicides (such as Mancozeb) should be applied **at least 6 hours before it rains** to avoid the fungicides to be washed away. Systemic fungicides (such as Ridomil) should be applied **at least 3 hours before it rains.** The leaves need to be dry before spraying (no dew on the leaves).


Contamination

Theme 13: Control of bacterial wilt

- Bacterial wilt causes **partial to complete wilting** of a plant even if there is enough water in the soil. When an infected tuber is cut in half, black or brown rings can be seen.
- The disease can spread via infected seed, water, roots, soil, farming tools, livestock and people.
- It also affects **other crops from the same family** such as chili, tomato, tobacco, and eggplant, as well as several weed species.
- There is no commercial chemical for controlling bacterial wilt.
- Plant **clean seeds** of **less susceptible varieties** in fields free from bacterial wilt.
- **Rotate** potato crops with other crops not belonging to the potato family, such as legumes and cereals.
- **Uproot and destroy** wilting plants together with soil around roots.
- Do not use compost with plant material from potato or crops from the same family.
- Clean and/or **disinfect farm tools** with fire or Jik before and after use. Wash/disinfect hands, shoes and pants between visits to different fields.
- Put a **stake** on all the hills where wilted plants were eliminated. Harvest the two neighboring plants separately, and sell or consume the tubers as ware potatoes.



Theme 14: Control of soft rot (or blackleg)

- Soft rot, also known as blackleg, alters tuber tissue into **liquid or soft rot** and causes **black lesions** at the base of the stem.
- Infected tubers rot either in field or in storage and produce a **bad smell.**
- Manage this disease by applying the **same control measures** recommended for bacterial wilt (clean seeds, rotation, uprooting of diseased plants and disinfecting farm tools).

Theme 15: Control of viral diseases

- Any plant infected with viruses must be eliminated immediately to avoid spread to other plants and transmission to further seed generations.
- Viral diseases are difficult to recognize in the field. With mild infections, plants can show no signs of disease at all.
- Moderate to severe infections cause **changes in the shape of plants** (leaf curling, yellowing of the leaves, bubbling leaves, short and stunted plants).
- Viral infections lead to **smaller potato tubers.** Selecting small tubers as seeds for the next season can reduce yields in the next season as these tubers are likely infected!
- Control the disease by planting **clean seeds** of **less susceptible varieties.**
- **Uproot and destroy** infected plants. If in doubt about whether a plant is infected or not, it is better to remove it from the field.
- Clean and/or **disinfect farm tools** with fire or Jik before and after use. Keep the field and surrounding area free of **weeds.**
- Insects such as aphids or whiteflies can spread viral diseases. Insecticides may be used to **control these insects**, but cautiously to avoid harm to the environment and human health.

Theme 16: Control of potato tuber moth

- Potato tuber moths (also called potato tuber worms) infest the crop in the field and move with tubers to the store.
- Moth larvae create **tunnels** in the tubers and form **mines** in leaves and stems. Avoid planting in too light and loose soil as it facilitates exposure of the tubers.
- Perform **high hilling** to protect the tubers.
- **Inspect the tubers** carefully before and during storage and remove each tuber showing openings/galleries and/or excreta.
- Use **natural repellent plants** such as Lantana or Eucalyptus that cause moths to fly away.
- The field may be sprayed with appropriate **insecticides** at 2–3 week intervals, but cautiously to avoid harm to the environment and human health.

Theme 17: Control of nematodes

- Two types of nematodes are known in potato production: **root-knot nematodes** (most widely spread) and **potato cyst nematodes.**
- Potato plants infested with nematodes may show stunting, yellowing of leaves and a tendency to wilt under moisture stress. Nematodes also cause **blemishes on tubers making** them unmarketable.
- Control of nematodes is primarily preventive because they are difficult to eradicate once they are present in the field.
- Plant **clean seeds** of **less susceptible varieties** in fields that are free from nematodes.
- Once nematodes are present in the field, **wait 5 years** before planting potato in the field again while avoiding crops from the same family (such as tomato, eggplant, chili).

Theme 18: Dehaulming

- **Dehaulming** is the act of removing or destroying potato shoots ahead of the complete maturity of the plant.
- Dehaulming **stops tuber growth** and **hardens the skin** of the tubers which protects them from damage and infection by diseases during harvest, transport, and storage. This is especially important in seed production.
- Towards the end of flowering (at around 80 days after planting), enter the field once a week and randomly dig up a few tubers. When about **75% of the tubers** have reached the **target size of 28-55 mm** (about the size of a chicken sized egg), dehaulming should be carried out immediately.
- Check each variety separately as the best time of dehaulming will differ among varieties.
- There are three methods of dehaulming: (1) **pulling out** the potato plants while stepping around their base, (2) cutting the stems with a **sickle** or **machete**, and (3) killing the foliage with herbicides. The second method is not desirable as it has the risk of transmitting diseases to the tubers through infected tools.

Theme 19: Harvesting, sorting and grading

- Harvest should be done when the tuber skin is sufficiently hardened, about **2 to 3 weeks after dehaulming.**
- To determine the right time for harvest, take a tuber and **rub it** between the thumb and index finger. If the skin is firm and cannot be removed by light rubbing, it is the right time for harvest.
- Harvesting should be done in **dry weather** and not when it is raining.
- Always handle the tubers **gently**, during digging up, packing and transport, to avoid wounding the tubers. Never throw or drop tubers from a height of more than 30 cm.
- Harvesting can be done by **hand** or using a **hoe**. Harvesting by hand takes longer and is more labour-intensive, but produces good quality and undamaged tubers.
- After digging up the tubers, leave them on the ground for a while (max 2 hours) to allow soil to dry out and fall off.
- After harvest, **sanitize the field** by gathering and destroying residues and rotten tubers.
- Tubers from diseased plants must **be harvested and collected last** and never used as seeds. They should be packed separately from other tubers.
- Healthy looking tubers should be **graded**, while still in the field and before packing, separating seed sizes: 28-35 mm (small size), 36-45 mm (medium size) and 46-55 mm (large size).
- To pack the seed tubers, do not use old bags previously used for packing tubers to avoid transmission of diseases.

Theme 20: Seed storage

- **Diffused Light Storage (DLS)** is the recommended system for storing large quantities of seed tubers.
- A DLS is made from locally available materials, with potatoes stored in **diffused (indirect) light** with **good ventilation.**
- In a DLS, you should have enough light to **read** a newspaper, not more, not less.
- DLS induces short, strong and coloured sprouts, which is ideal for potato production.
- A DLS is usually made of **wooden planks set at least 1 inch apart** to allow light and air to enter, and one or more **translucent iron roofing sheets.**
- An **aphid proof net** should be used to line the inner walls to prevent insects from entering the store.
- Arrange tubers in **thin layers** (2-3 tubers) so that each tuber receives enough light and for easy inspection.
- Keep different varieties, generations and seed lots in **different shelves or trays.**
- Properly **label** each lot, indicating variety name, generation and harvest date.
- Regularly **inspect** the store and remove rotten tubers.
- Four to six weeks before planting, the main sprout should be taken off to promote the development of more lateral sprouts.

Appendix 1: Characteristics of varieties available in Rwanda

Variety name	Code	Year of release	Maturity period (days)	Attainable yield (t/ha)	Dormancy period (days)	Adaptability	Characteristics
Victoria	381381- 20	1996	90-110	25	40	Highlands	Pink, susceptible to late blight, fresh consumption and processing (chips)
Gikungu	381233-24	1992	100-120	35	85	Highlands	Red, resistant to late blight, fresh consumption and processing (chips)
Kigega	383120-14	1992	100-120	40	70	Highlands	Red, resistant to late blight, processing (chips)
Mizero	386003-2	1992	100-120	40	55	Highlands	White, tolerant to late blight
Mugogo	383140-6	1992	100-120	25-30		Highlands	White, tolerant to late blight
Nderera	381391-13	1992	100-120	35	75	Highlands	Red, resistant to late blight
Ngunda	381233-24	1992	100-120	50	70	Highlands	White, resistant to late blight

Variety name	Code	Year of release	Maturity period (days)	Attainable yield (t/ha)	Dormancy period (days)	Adaptability	Characteristics
Mabondo	8212-6	1989	100-120	30-35	40	Highlands	White, reddish eyes, resistant to late blight, processing (chips)
Kirundo	RW 8212-5	1989	100-120	30	40	Highlands	White, mid-tolerant to late blight
Kirundo	RW 8212-5	1989	100-120	30	40	Highlands	White, mid-tolerant to late blight
Cruza	720118-13	1985	120-130	20-30	30	Highlands	White with pink line, resistant to late blight, tolerant to bacteria wilt, short dormancy
Gasore	Graso-28	1983	90-100	10-18		Highlands	Early maturity, processing (chips)
Kinigi	378699-2	1983	100-120	20-30	85	Highlands	Red, tolerant to late blight, fresh consumption and processing (chips)
Marirahinda	384216-7	1983	100-120	30-40		Highlands	

Variety name	Code	Year of release	Maturity period (days)	Attainable yield (t/ha)	Dormancy period (days)	Adaptability	Characteristics
Nseko	720055-8	1983	100-120	20-30		Highlands	
Sangema	800949	1983	100-120	20-25	110	Highlands	Pink, mid-tolerant to late blight, fresh consumption, processing (chips, crisps)
Gahinga	370097-12	1983	100-120	25-40		Highlands	Red, tolerant to late blight
Nkunganire	393280.64	2019	90-120	30-35	>120	Highlands	Red, resistant to late blight, mid-susceptible to bacterial wilt, fresh consumption and processing (chips and crisps)
Ndeze	398190.615	2019	90	20-25	90	Highlands	White, resistant to late blight, fresh consumption and processing (chips and crisps)
Twihaze	393371.58	2019	100-120	30-50	90	Highlands	White, resistant to late blight, susceptible to bacterial wilt
Kazeneza	393077.159	2019	90-120	30-40	>120	Highlands	White, resistant to late blight, mid-susceptible to bacterial wilt, fresh consumption and processing (chips and crisps)

Variety name	Code	Year of release	Maturity period (days)	Attainable yield (t/ha)	Dormancy period (days)	Adaptability	Characteristics
Izihirwe	396018.241	2019	90-120	30-50	90	Highlands	Red, resistant to late blight
Twigire	392657.8	2020	90-110	30	90	Highlands	White, resistant to late blight, mid-resistant to bacterial wilt, processing (chips and crisps)
Gisubizo	378699.2	2020	120-150	35	60	Highlands	Red, mid-resistant to late blight, fresh consumption and processing (chips)
Ndamira	Shangi	2020	90-100	30-40	< 30	Highlands	Cream, mid-resistant to late blight, processing (chips and crisps)
Kerekezo	392797.22	2020	90-110	30	90	Highlands	Red, mid-resistant to late blight, mid-susceptible to bacterial wilt
Jyambere	394611.112	2020	100-120	25	100	Highlands	Red, resistant to late blight, susceptible to bacterial wilt, processing (chips and crisps)
Seka	398190.89	2020	100	30	90	Highlands	White, heat-tolerant, resistant to late blight, processing (chips)